Northeast Extreme Tee Beam
"NEXT Beam"

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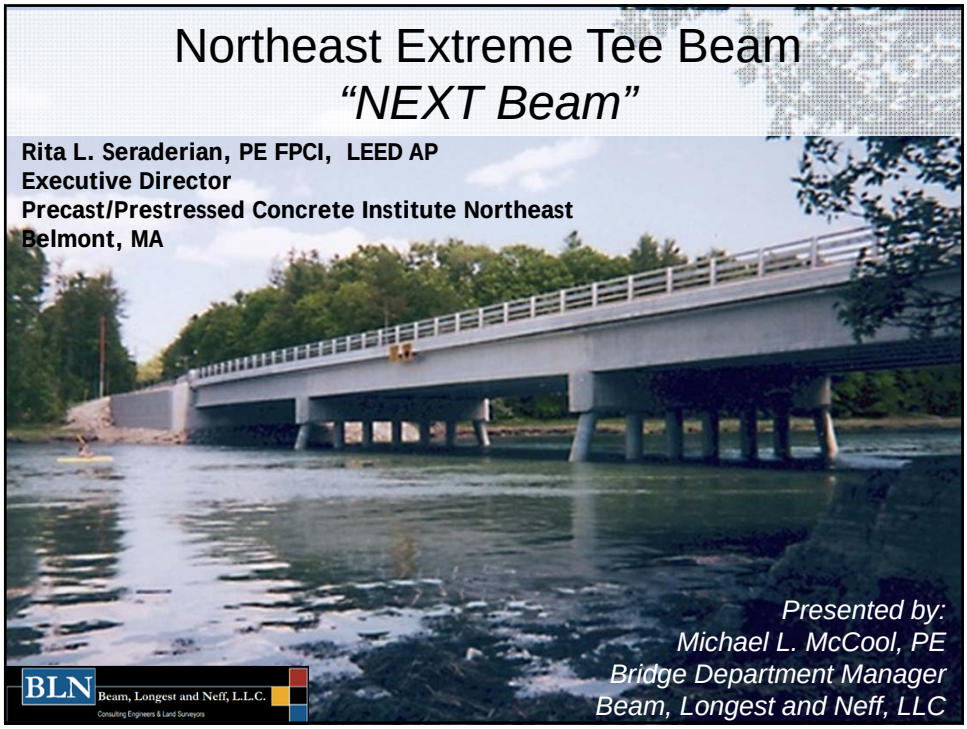

Presented by:
Michael L. McCool, PE
Bridge Department Manager
Beam, Longest and Neff, LLC

PCINE Bridge Technical Committee

- Established in 1990
- State DOT's Engineers, Consultants & Precasters
- Focus is on Updating and Developing Regional Standards for ABC Bridge Construction since 2004

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Joe Carrara - J. P. Carrara & Sons
Ben Cota - J. P. Carrara & Sons
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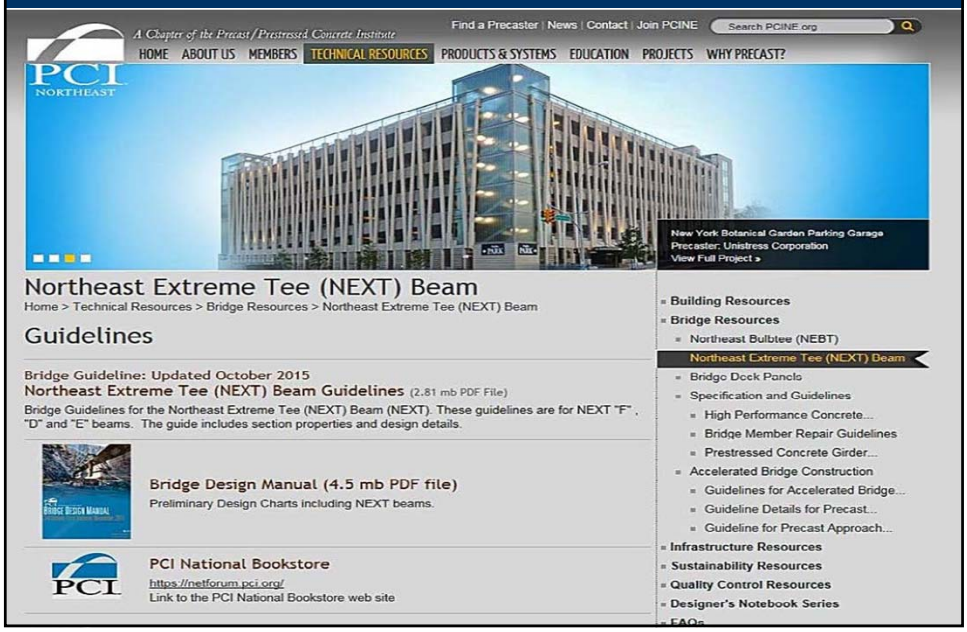
David Scott - NHDOT
Mike Savella - Rhode Island DOT
Rob Young – Vermont AOT

PCI

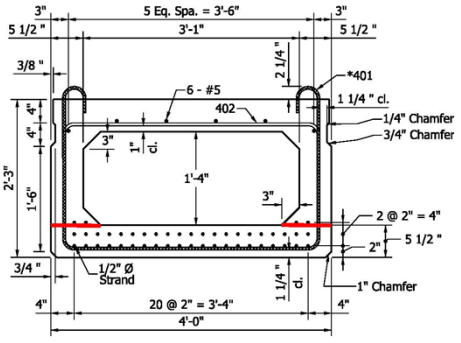
Reports are available at www.pcine.org



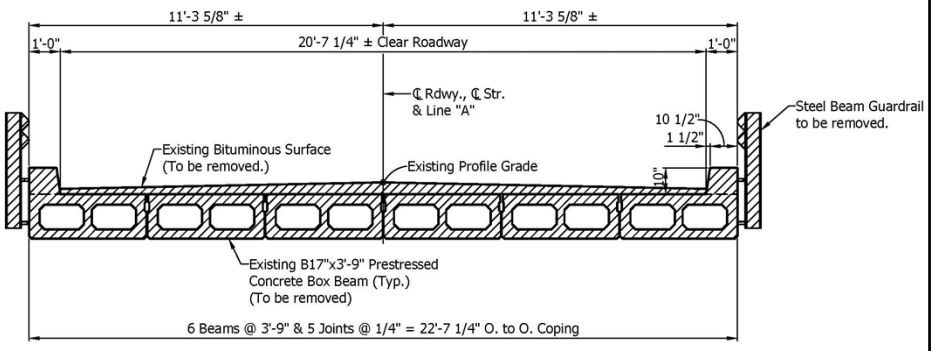
Why Develop a New Bridge Section?

Box Beams have limitations

- Closed cells limit inspection
- Geometric limitations
- Durability concerns
- Multi-step fabrication process



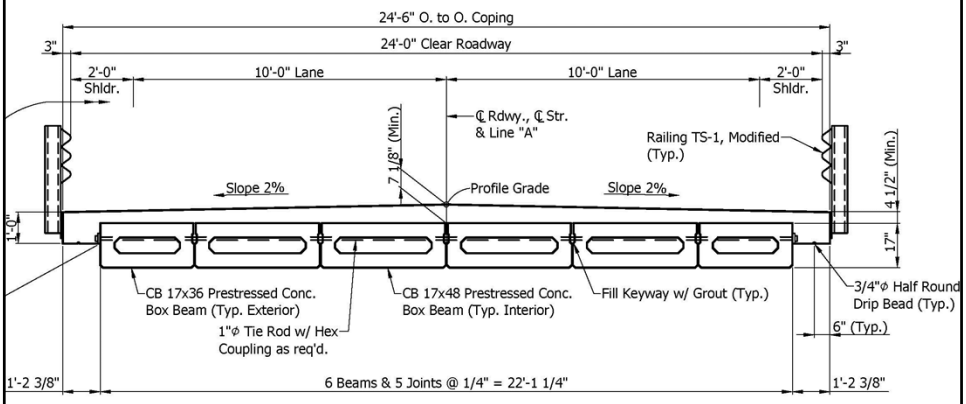
Indiana Adjacent Box Beam Bridges



TYPICAL SECTION - EXISTING

Scale: 3/8"=1'-0"

Indiana Adjacent Box Beam Bridges



TYPICAL SECTION - PROPOSED

Scale: 3/8"=1'-0"

Indiana Adjacent Box Beam Bridges

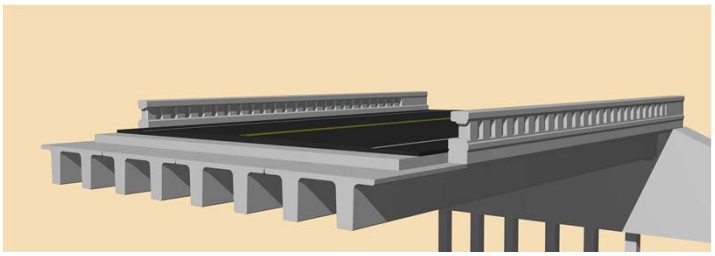



Indiana Adjacent Box Beam Bridges



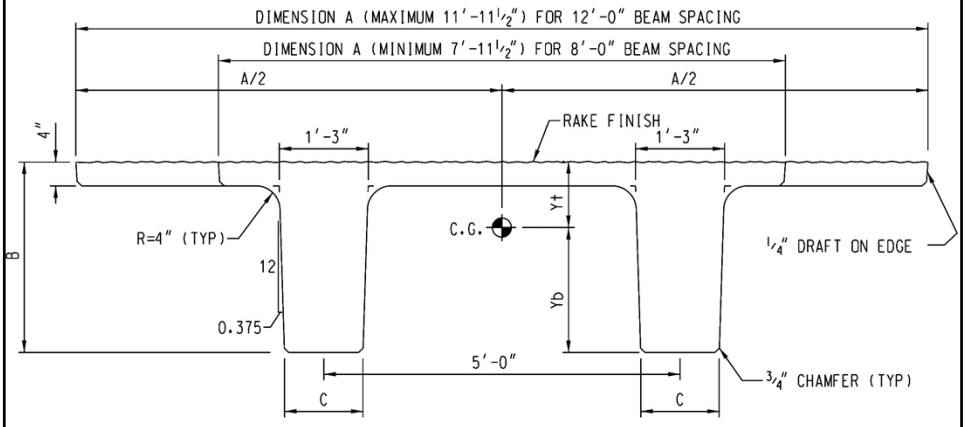

Development of the NEXT Beam

- Started in 2006 – Completed in 2008
- Open Double-Tee, Single-Pour Production
- Reduced Fabrication and Installation Cost
- Width varies from 8 ft to 12 ft
- Spans: 20 ft to 80 ft
- Works well for Accelerated Construction (ABC)



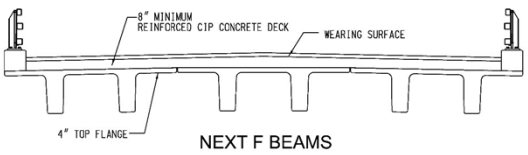
Development of the NEXT beam

Depth 24” – 36” in 4” increments
Typical Span Range 20’ – 80’
Width will vary 8’-0” – 12’-0”

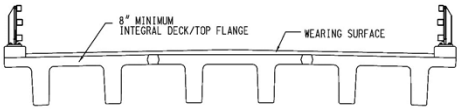


NEXT F BEAM

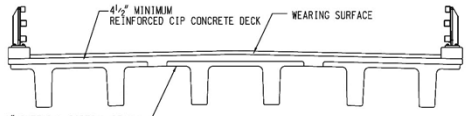
NEXT Beam Shapes



NEXT F BEAMS



NEXT D BEAMS



NEXT E BEAMS

NEXT "F" plus 8" CIP Deck

- No Forming between Flanges
- Easily Accommodates Vertical Curves w/CIP Topping
- Easily Handles Camber Variations between Members

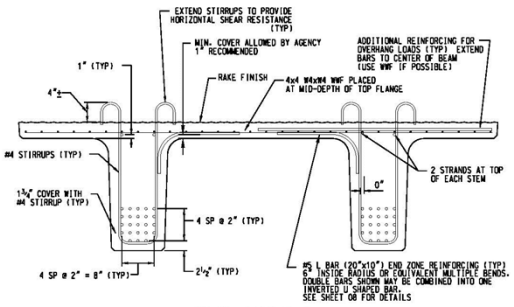
NEXT "D" no CIP Deck

- No CIP Topping/Deck
- Best Section for ABC
- Special Concrete for Flange Connection

NEXT "E" plus 4" CIP Deck

- Uses Less Topping & Reinforcement
- Flange Connection Made with CIP
- Easily Accommodates Vertical Curve
- Easily Handles Camber Variations between Members

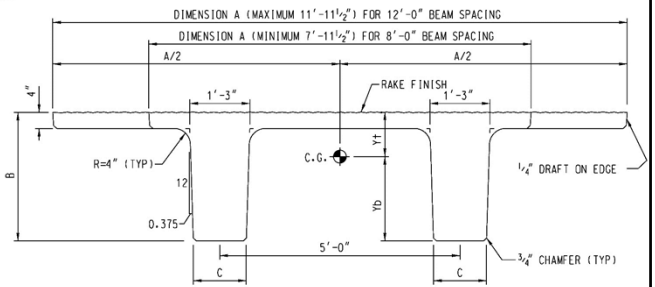
Development of the NEXT beam



NEXT F BEAM

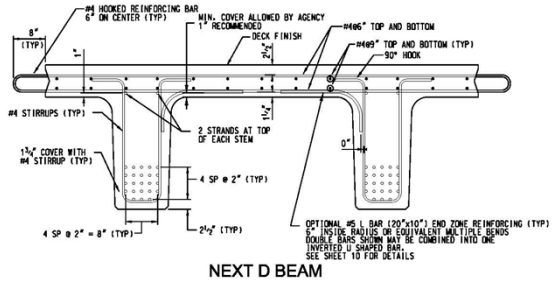
NEXT "F" BEAM

- Top Flange to act as form only
- Shear Reinforcement kept to #4 bars to maximize cover
- Designer to verify flange reinforcement based on deck thickness



NEXT F BEAM

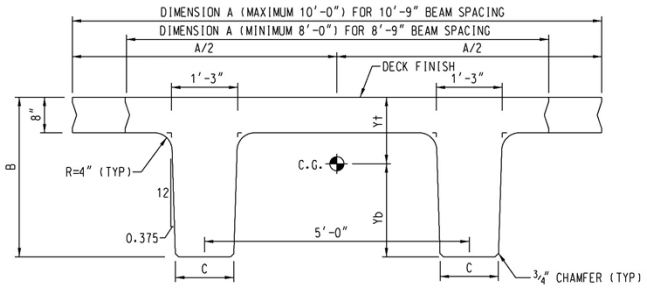
Development of the NEXT beam



NEXT D BEAM

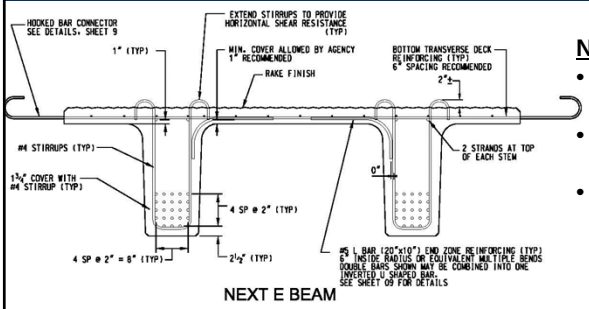
NEXT "D" BEAM

- Top Flange is a structural deck
- Shear Reinforcement kept to #4 bars to maximize cover



NEXT D BEAM

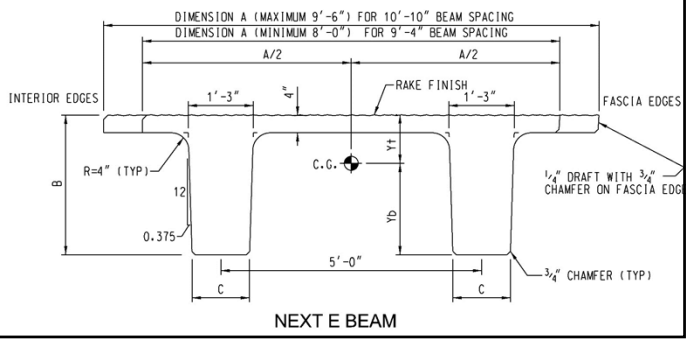
Development of the NEXT beam



NEXT E BEAM

NEXT "E" BEAM

- Top Flange to act as bottom portion of the deck
- Shear Reinforcement kept to #4 bars to maximize cover
- Design of deck should be based on conventional CIP concrete deck



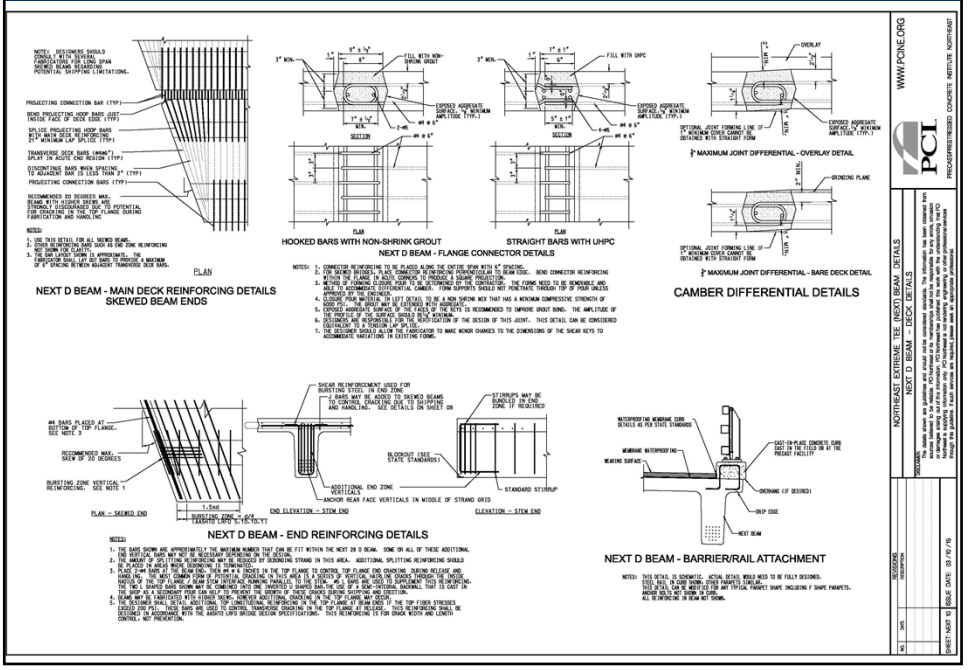
NEXT E BEAM

NEXT Beam Properties

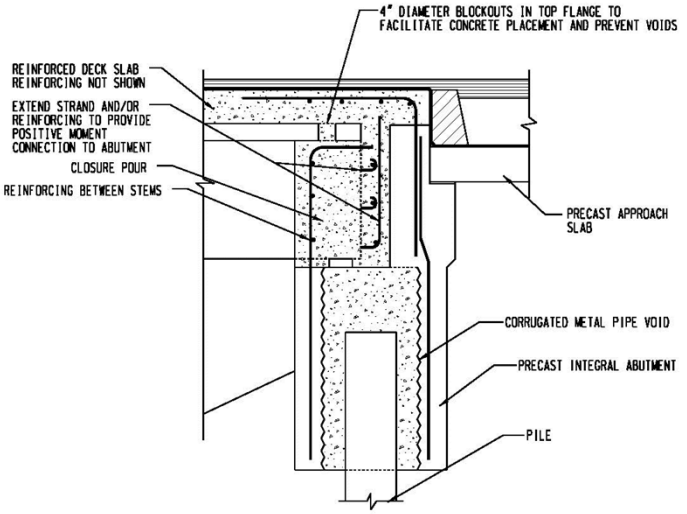
NEXT BEAM - SECTION PROPERTIES

BEAM DESIGNATION	BEAM WIDTH INCHES	BEAM DEPTH INCHES	BASE STEM WIDTH INCHES	AREA IN^2	I IN^4	Yb INCHES	Yt INCHES	St IN^3	Sb IN^3	WEIGHT PLF
	A	B	C			D	E			
MINIMUM WIDTH BEAMS										
NEXT 36 F	95.50	36.00	13.00	1287	160240	21.77	14.23	11261	7361	1341
NEXT 32 F	95.50	32.00	13.25	1182	115813	19.51	12.49	9272	5936	1231
NEXT 28 F	95.50	28.00	13.50	1075	79901	17.24	10.76	7426	4635	1120
NEXT 24 F	95.50	24.00	13.75	966	51823	14.95	9.05	5726	3466	1006
NEXT 36 E	96.00	36.00	13.00	1289	160546	21.79	14.21	11298	7368	1343
NEXT 32 E	96.00	32.00	13.25	1184	116028	19.53	12.47	9305	5941	1233
NEXT 28 E	96.00	28.00	13.50	1078	80042	17.26	10.74	7453	4637	1123
NEXT 24 E	96.00	24.00	13.75	969	51906	14.97	9.03	5748	3467	1009
NEXT 40 D	96.00	40.00	13.00	1667	238087	25.47	14.53	16381	9349	1736
NEXT 36 D	96.00	36.00	13.25	1562	176727	23.03	12.97	13630	7672	1627
NEXT 32 D	96.00	32.00	13.50	1456	126155	20.57	11.43	11039	6132	1517
NEXT 28 D	96.00	28.00	13.75	1347	85684	18.07	9.93	8626	4743	1403
MAXIMUM WIDTH BEAMS										
NEXT 36 F	143.50	36.00	13.00	1479	185525	23.36	12.64	14678	7942	1541
NEXT 32 F	143.50	32.00	13.25	1374	134258	20.98	11.02	12183	6399	1431
NEXT 28 F	143.50	28.00	13.50	1267	92661	18.57	9.43	9826	4990	1320
NEXT 24 F	143.50	24.00	13.75	1158	60045	16.12	7.88	7620	3725	1206
NEXT 36 E	114.00	36.00	13.00	1361	170830	22.44	13.56	12598	7613	1418
NEXT 32 E	114.00	32.00	13.25	1256	123575	20.14	11.86	10419	6136	1308
NEXT 28 E	114.00	28.00	13.50	1150	85300	17.81	10.19	8371	4789	1198
NEXT 24 E	114.00	24.00	13.75	1041	55322	15.45	8.55	6470	3581	1084
NEXT 40 D	120.00	40.00	13.00	1859	258217	26.55	13.45	19204	9724	1936
NEXT 36 D	120.00	36.00	13.25	1754	191497	24.02	11.99	15978	7974	1827
NEXT 32 D	120.00	32.00	13.50	1648	136539	21.44	10.56	12926	6369	1717
NEXT 28 D	120.00	28.00	13.75	1539	92622	18.80	9.20	10072	4926	1603

NEXT Beam Details

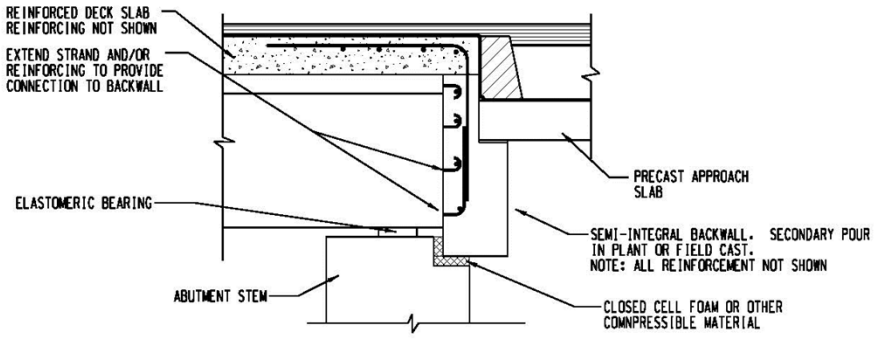


NEXT Beam Details



NEXT F - SAMPLE INTEGRAL ABUTMENT SECTION

NEXT Beam Details

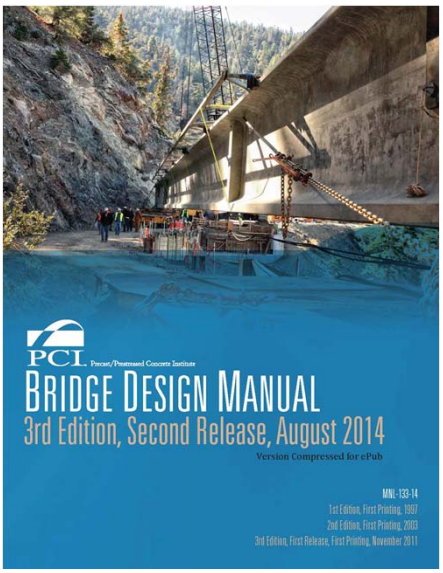


NEXT F - SAMPLE SEMI-INTEGRAL ABUTMENT SECTION

PCI BRIDGE DESIGN MANUAL

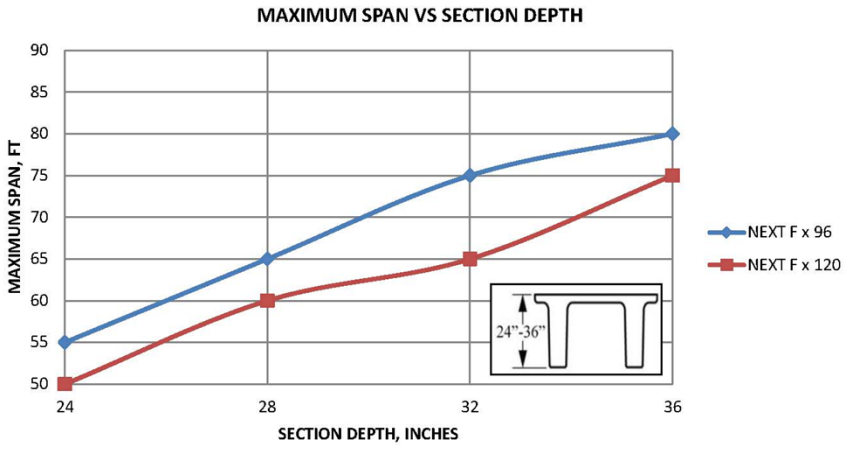
Chapter 6 – Preliminary Design
- 6.9 Prelim. Design Charts
  - NEXT Type D Beams
  - NEXT Type F Beams
- 6.10 Prelim. Design Data
  - NEXT Type D Beams
  - NEXT Type F Beams

Chapter 9 – Design Examples
- Example 9.7
  - NEXT Type 36 D
  - Single Span
  - Non-Composite Deck
- Example 9.8
  - NEXT Type 36 F
  - Single Span
  - Composite Deck



PCI BRIDGE DESIGN MANUAL

Chart NEXT-4
NEXT Type F Beams



PCI BRIDGE DESIGN MANUAL

*A minimum concrete transfer strength of 3.0 ksi is recommended by PCI MNL-116 section 5.3.17.
**Final camber is net deflection after all losses and noncomposite and composite dead loads are applied.

Table NEXT-5
NEXT Beam Type F x 96

Spacing ft	Span ft	Slab Thickness in.	f'_{ci} ksi	No. of Strands	Final Camber in.**	f_b @ L/2 ksi	f_t @ L/2 ksi	M_u @ L/2 ft-kips	M_r @ L/2 ft-kips	Control
NEXT Beam 24 F x 8-ft-Wide Beam										
8	20	8	1.055*	8	0.01	-0.116	0.457	616	753	Strength
8	25	8	1.688*	10	0.07	-0.049	0.502	820	1,034	Strength
8	30	8	2.232*	12	0.13	-0.074	0.602	1,041	1,277	Strength
8	35	8	2.769*	14	0.18	-0.144	0.727	1,279	1,515	Strength
8	40	8	3.299	16	0.22	-0.26	0.877	1,535	1,748	Stress
8	45	8	3.822	18	0.20	-0.449	1.061	1,839	1,977	Stress
8	50	8	4.816	22	0.41	-0.427	1.237	2,177	2,400	Stress
8	55	8	5.716	26	0.53	-0.501	1.467	2,532	2,785	Stress
NEXT Beam 28 F x 8-ft-Wide Beam										
8	20	8	1.133*	8	0.04	0.071	0.332	640	904	Strength
8	25	8	1.098*	8	0.01	-0.182	0.457	853	922	Strength
8	30	8	1.652*	10	0.07	-0.132	0.511	1,083	1,229	Strength
8	35	8	2.139*	12	0.11	-0.154	0.609	1,331	1,511	Strength
8	40	8	2.621*	14	0.16	-0.212	0.727	1,598	1,788	Strength

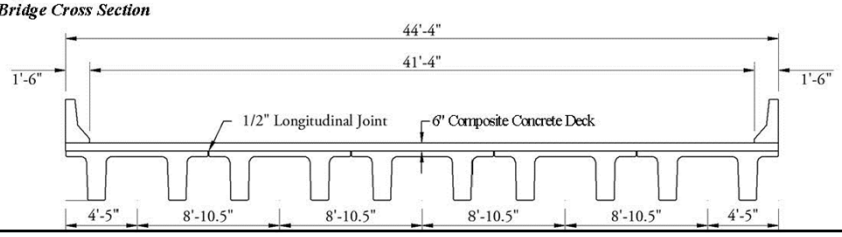
PCI BRIDGE DESIGN MANUAL

9.8 Transformed Sections, Shear General Procedure, Refined Losses

9.8.1 INTRODUCTION

This design example demonstrates the design of an 80-ft, single span, PCI Northeast Extreme Double-Tee bridge with no skew. This example illustrates in detail the design of a typical interior beam at the critical sections in positive flexure, shear, and deflection due to prestress, dead loads, and live load. The superstructure consists of five beams spaced at 8-ft 10½-in. centers, as shown in **Figure 9.8.1-1.** Beams are designed to act compositely with the 6-in.-thick cast-in-place concrete deck to resist all superimposed dead loads, live loads, and impact. A ½-in.-thick wearing surface is considered to be an integral part of the 6-in.-thick deck. Design live load is HL-93. The design is accomplished in accordance with *AASHTO LRFD Bridge Design Specifications*, Fifth Edition, 2010, and the 2011 Interim Revisions. Elastic stresses from external loads are calculated using transformed sections. Shear strength is calculated using the general procedure. Time-dependent prestress losses are calculated using the refined estimates.

Figure 9.8.1-1
Bridge Cross Section



Top Tension Crack Memo

Limit the top tension stresses to 0.2 ksi at release.
Limit Skew to 20 degrees.

Bridge beams where minor controlled transverse cracking is acceptable.
AASHTO LRFD Bridge Design Specifications, Article 5.9.4.1.2. AASHTO Table 5.9.4.1.2-1

Management of top tension stresses at beam ends:

- 25% Debonding
- Bonded top tension reinforcement will not prevent cracks.
- Top strand should not be used to fulfill this article.
- Sand spacing of mild reinforcement should be per AASHTO Article 5.7.3.4.

AASHTO LRFD Bridge Design Specifications, Article 5.9.4.1.2.

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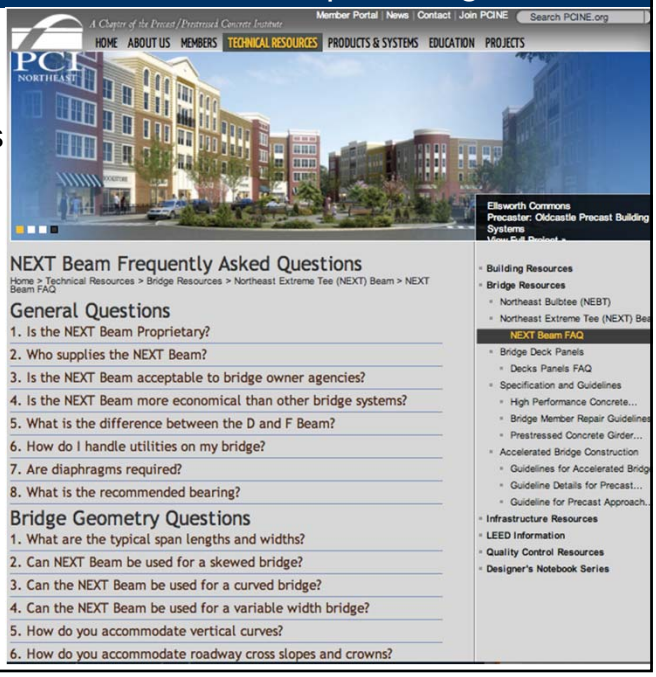
Additional Guidance on website www.pcine.org

- FAQ
- Design Assumptions



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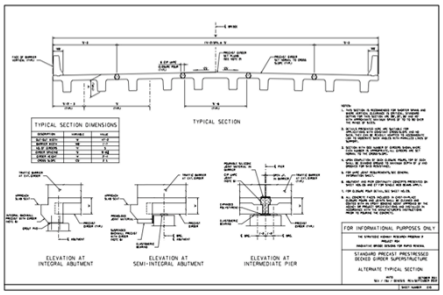
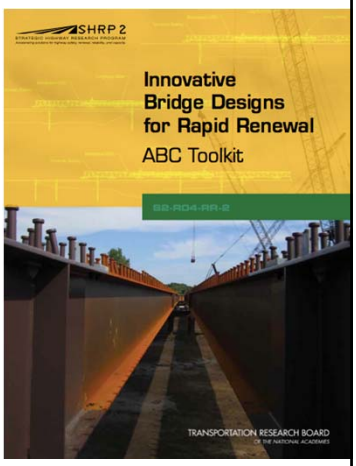
SHRP2 Research Project

Transportation Research Board Project
SHRP 2 - Innovative Bridge Designs for Rapid Renewal
ABC Toolkit

www.trb.org/main/blurbs/168046.aspx





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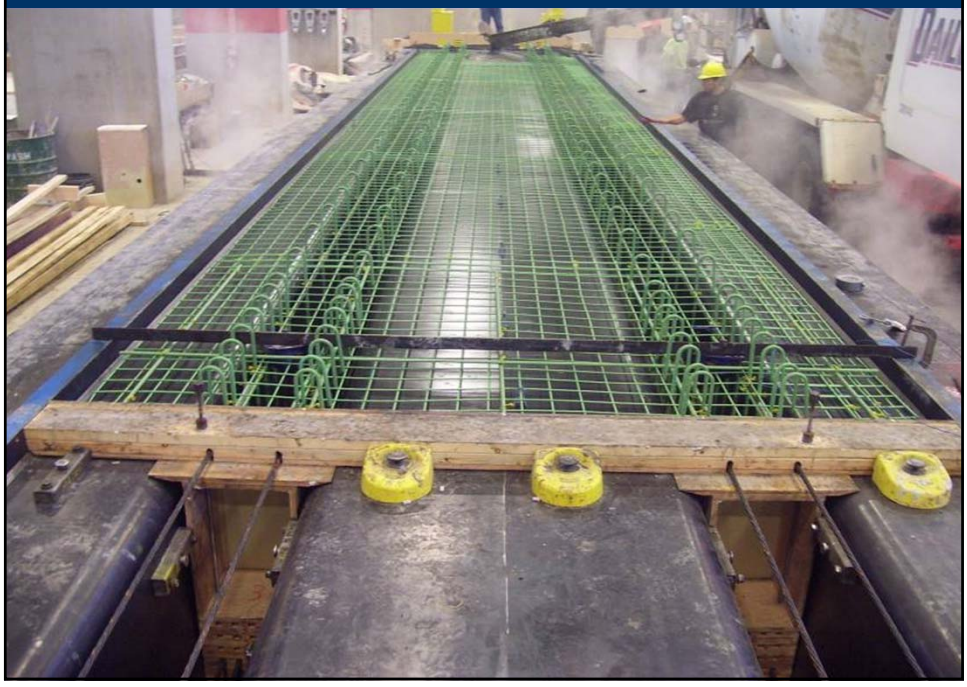
NEXT Beam Production



NEXT Beam Production

NEXT Beam Shipping

NEXT Beam Shipping

Maine DOT Project

Maine DOT Project

Maine DOT Project

Maine DOT Project

Maine DOT Project

South Worthington, MA – Total Precast Built in 60 Days

South Worthington, MA – Total Precast Built in 60 Days

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TIMELINE NEXT Beam Developed in 2008

First NEXT Beam Cast

2009

7 Bridges

First NEXT D bridges are Built in Maine & Vermont MA and NY Build first Bridges

2011

Logan Airport uses NEXT beams for Runway Extension and new Airport Viaduct

2011-12

2010

First NEXT F Bridges Built York ME and Kittery ME

2 Bridges

2012

First Curved Flange Project

NJ and RI build their first projects

18 Bridges

2013

NY built First Lateral Slide

25+ Projects

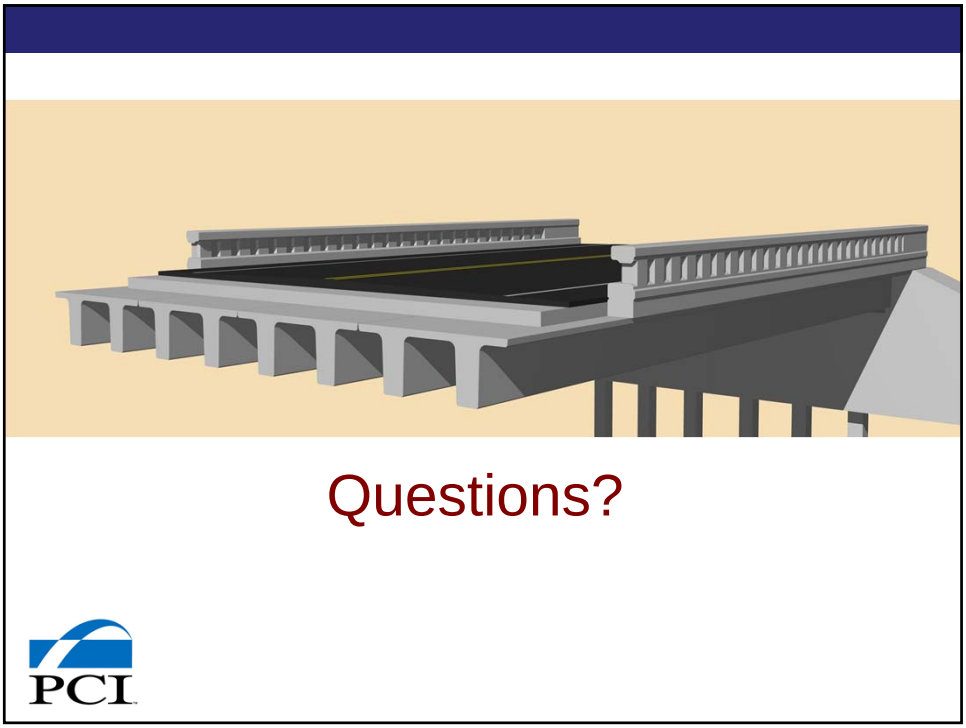
NEXT Beam Acceptance - States with NEXT Beams

Massachusetts DOT
Vermont AOT
Maine DOT
Rhode Island DOT
New Hampshire DOT
New York State DOT and New York City DOT
New Jersey DOT
Delaware DOT
Pennsylvania DOT
Virginia DOT

States with NEXT Beam in Design/Construction:

Connecticut DOT

New Brunswick has also adopted the new shape for Canada



Questions?